

EMBODIED METHODS TO IMPROVE CHILDREN'S MEMORY

When kids act out: A comparison of embodied methods to improve children's memory for a story

Abstract

Over the last decade, embodied cognition, the idea that sensorimotor processes facilitate higher cognitive processes, has proven useful for improving children's memory for a story. In order to compare the benefits of two embodiment techniques, Active Experiencing (AE) and indexing, for children's memory for a story, we compared the immediate recall of different types of idea units across three conditions. Participants were between the ages of 7-11 and were randomly allocated to experimental condition. The experimental groups were matched on comprehension ability and age. In the indexing condition, children acted out a short story using a playset (i.e., a Playmobil ® playset with figurines), in the AE condition, children read the story using enactment and during the control condition, children simply read the story. We predicted that children in the indexing condition would recall more action-based idea units, whilst children in the AE condition would recall more descriptive and dialogic idea units. Children in the AE condition recalled more descriptive idea units than in the control conditions, whilst in the indexing condition, only poorer comprehenders recalled more descriptive information. Our findings suggest that these two embodiment techniques effect different components of reading comprehension and that future research should investigate these differences more specifically.

Keywords: embodied cognition, the indexical hypothesis, active experiencing, memory

Introduction

Over the last decade, embodied cognition, the idea that sensorimotor processes facilitate higher cognitive processes, has proven useful for improving skills necessary for reading comprehension, the process of extracting meaning from a text (Glenberg, 2011; Fischer & Zwaan, 2008; de Koning & van der Schoot, 2013; Leopold & Leutner, 2012; Marley & Szabo, 2010).

For example, Glenberg et al. (2004) found that children who indexed what they were reading about (e.g., farm animals) to playset pieces they could manipulate remembered more action sentences from the story than children who only read the story (Glenberg et al., 2004). Based on this result, Glenberg et al. (2004) concluded that externalising a story improved children's memory for that story – a skill necessary for successful reading comprehension (Oakhill & Yuill, 1996). Glenberg et al. (2004) attributed their findings to the Indexical Hypothesis (IH), which argues that language is understood in three steps: (1) by mapping words and phrases to objects in the environment, (2) by figuring out how the objects can be used (i.e., deriving affordances) and finally (3) by meshing the affordances into a doable set of actions as directed by a sentence's syntax (Glenberg, Brown & Levin, 2007; Glenberg et al., 2004; Glenberg & Robertson, 1999). The IH is rooted in embodied cognition theory because it claims grounding language is necessary for its comprehension.

Additionally, Glenberg et al. (2004) found that children who imagined interacting with the same objects they previously manipulated were better at recalling the material than children who only manipulated the playset again. This result suggests that internalising the indexing process also improves memory for a story (Glenberg et al., 2004).

In a similar approach, Noice and Noice (2006) found that an acting technique called Active Experiencing (AE), the process of internalising a text through emotional expression (i.e., for dialogue, adopting the emotionality of the story's characters; for descriptive phrases,

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expressing the emotionality of emotionally-driven language, e.g., “Jenny was sitting *eagerly* at the kitchen table”) and gesture, is also a useful tool for enhancing recall. Noice and Noice (2001) specifically emphasised the importance of enactment in AE, which suggests that AE is an embodiment technique. More specifically, the researchers contended that for AE to be most effective, intentions in a script must be expressed motorically in addition to emotionally (Noice & Noice, 2001). For example, in a study with undergraduates from an introductory acting class, they found that participants remembered more of their character's lines when asked to read their part out loud using emotional expression and “any bodily movement [...] deem[ed] appropriate” compared to only using emotional conviction (Noice & Noice, 2001, pp. 821). It is important to note that no research involving AE has focused on children.

Although no study has looked at the usefulness of AE for improving children's memory of a narrative text, other studies have demonstrated the benefits of gesture on children's comprehension, which is related to memory (Oakhill & Yuill, 1996). For example, Cook, Mitchell and Goldin-Meadow (2008) found that children who gestured whilst learning a new math concept understood that concept better than children who discussed the concept with the instructor. Cook et al. (2008) attributed these findings to the possibility that gesturing makes it easier for children to form well-structured schemas about a concept. According to Cook et al. (2008), this might be because gesturing whilst learning minimises demands on working memory, freeing up resources for encoding information in a more lasting format. In terms of Active Experiencing, Cook et al.'s (2008) finding suggests that the gestural component of AE enhances children's ability to encode and retain information from a story. Using a dual-task paradigm, Ping and Goldin-Meadow (2010) confirmed Cook et al.'s (2008) hypothesis. Specifically, children were asked to explain whether two containers had the same amount of water (with or without gesture) whilst remembering two words. Their performance on the second task reflected their cognitive effort on the first task. The

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study found that children who gestured during the first task remembered the two words better, which was attributed to gesture minimising demands on working memory. Also, gesturing was found to minimise cognitive effort whether the objects were present or absent. Very recently, Cutica, Ianì, & Bucciarelli (2014) found that asking children to gesture whilst reading scientific texts, “to help them understand the text”, improved their memory for a story.

Based on previous research that has demonstrated the beneficial effects of internalisation and gesture on children's memory for a story, the current study will compare well-established benefits of indexing to the proposed benefits of AE for children's immediate recall of a narrative text (after a two minute distractor task). The positive effects of child play on overall cognitive ability (Prehm, Logant & Towle, 1972; Singer, Golinkoff, Hirsh-Pasek, 2006) suggest that AE will yield beneficial effects for reading comprehension. Another reason to compare the two techniques is because when discussing the effect of embodiment on memory and comprehension, past research has cited Glenberg and Noice and Noice interchangeably, which may not be accurate (e.g. Cook et al., 2008). Additionally, because indexing focuses on movement and action whilst AE focuses on dialogue and plotline, we suspect that the two techniques will have differential effects on memory for different types of information. More specifically, Noice and Noice (2001) found that AE improved adult's memory for dialogue from a play (i.e., a scene) compared to only emotional expression. Thus, we predicted that AE would improve readers' memory for dialogic idea units and possibly descriptive idea units relevant to the plot of the story. In terms of indexing, Glengerg et al. (2004) only demonstrated that their intervention improved children's memory for action sentences. Thus we predicted that indexing would improve readers' memory for action idea units.

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Thus, in comparison with the current study Glenberg et al.'s (2004) previous research only looked at the effects of indexing on action sentences. In comparison, the current study compares the effects of AE and indexing on the recall of descriptive, dialogic and action-based idea units in order to measure the differential effects of the two approaches across unit type. Children between the ages of 7 and 11 were asked to read one of two short stories in one of three conditions (indexing, AE or control). In the indexing condition, children acted out a story using a Playmobil® playset whilst reading the story out loud, in the AE condition, children read the story using gesture and emotional expression and during the control condition, children simply read the story out loud. We predicted that children in the indexing condition would recall more movement information overall whilst children in the AE condition children would recall more script-like dialogic information and descriptive information overall.

The current study also investigated the effect of comprehension ability on the efficacy of the embodiment techniques because of the close relationship between immediate recall and comprehension (Oakhill & Yuill, 1996). In terms of the effect of skill training on comprehension ability, Yuill and Oakhill (1988) found that poor comprehenders improved from training in a skill related to reading comprehension (i.e., inference making) more than average comprehenders. Thus, we predicted that poorer comprehenders in particular would benefit from the two embodiment techniques.

Methods

Participants

Seventy-two volunteers (29 males and 42 females) between the ages of 7 and 11 years old ($M = 111.74$ months, $SD = 11.50$) were recruited between July 2012 and March 2013 (see Table 1 for demographics and comprehension scores). Across both test groups, there was an

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even spread of participants per condition ($AE = 25$, *Indexing* = 24, *Control* = 23). The participants tested in the summer of 2012 had just completed years 3-6 of primary school in the UK; they were recruited from summer play schemes, i.e, holiday childcare programmes for children between the ages of 6-14 in the UK. Thirty additional children in years 3-5 (7-10 years old) from primary schools were recruited in March 2013. No child was excluded. Before working with each child, we obtained written consent from a parent or guardian in accordance with the ethics procedures set out by the University's School of Psychology Research Ethics Committee. Additionally, before testing began, every child was informed that they could stop and leave at any point during the study. No child chose to do so.

<Table 1 here>

Apparatus

Participants in the indexing condition manipulated a Playmobil® play set made up of a garden scene (a fence and a bike), a kitchen scene (a kitchen table, a cooker and a fridge) and 3 characters (a mother, a father and either a male or female adolescent). Participants were verbally informed who the playset-people represented in the text. A digital voice recorder was used to record the child reading the test story and the recall task.

Materials

The Neale Analysis of Reading Ability- R (NARA-II) (Form 2), administered as a listening comprehension test, was used for the group comprehension assessment (Neale, 1997). There was one practice story, read out loud as an example, and six test stories in total. Children were given an answer booklet with 4-8 comprehension questions per story (including the practice story where children had to write their answers individually. For the

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main experiment, children were assigned one of two short stories written by the experimenter (180 words each). The stories differed in plot and the gender of the protagonist. An example of a story is shown in Table 2 (copies of both stories can be found in Appendix I). Each story was divided into descriptive, dialogic and action idea units based on Omanson's (1982) guidelines for identifying idea units. The process resulted in an unequal number of idea units in the two stories: One story had 31 idea units (6 action, 18 descriptive and 7 dialogic) whilst the other had 28 (6 action, 16 descriptive and 6 dialogic).

<Table 2 here>

Design

In the current study, there were two independent variables: condition type and idea-unit type. Condition type (three levels: Indexing, AE or Control) was between-subjects, whilst idea-unit type (three levels: action, dialogic and descriptive idea units) was a repeated-measures variable. The dependent variable was the proportion of idea units correctly recalled. Proportions were used instead of the raw scores because the two test stories had different numbers of idea units (31 compared to 28). Two different test stories were used in order to control for the effects of story-plot and the gender of the protagonist. The stories were allocated evenly between the three conditions by alternating story-type between participants. Covariates included NARA-II score and age (in months). Children were randomly allocated to groups with the provision that groups were matched on NARA-II, year at school and age.

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Procedure

Set-up. Participants were tested by the experimenter in a quiet room at a primary school, activities centre or their own home (in audible distance of a teacher, group leader or parent). They were introduced to the study either on their own or in groups of 2-8. The children participating were informed that they would be taking part in a two-part activity focused on improving memory and reading comprehension and if they started to feel uncomfortable with the study, they could withdraw at anytime.

Comprehension Assessment. For the first part of the study, participants were administered the NARA-II as a listening comprehension test (either on their own or in groups of 2-8). The test was administered identically for all group sizes. For the NARA-II, participants either sat around a kitchen table, a large conference-style table or at desks. They were informed that the assessment consisted of one practice story, six test stories and corresponding questions for each story that the experimenter would read out loud. Participants were required to answer the corresponding comprehension questions in their test booklets on their own. The researcher remained vigilant in order to prevent possible conferring. The participants were told not to answer a question until it was read out loud. After the practice text and corresponding questions were read out loud by the experimenter, the children were asked if they had any questions and then the experimenter continued to the test stories and questions. After completing all six stories and questions, participants were thanked for their participation and sent back to their classroom or play scheme.

Test Session. For the second part of the study, the experimenter introduced the procedure to each participant alone; participants were tested individually. The experimenter first told each child that they would be read a short story and then asked to read the story out

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loud to the experimenter using a technique beneficial for reading comprehension.

Participants in the indexing condition were told that they would be able to use a playset to act out the story. Before reading the story out loud, the experimenter demonstrated the task by reading a practice passage (Appendix II) out loud whilst manipulating the Playmobil® characters. For the AE condition, the experimenter read the practice passage out loud whilst acting it out with changes in vocal inflection (to differentiate between the parent and child) and a few physical movements to convey actions or enhance dialogue (examples presented in Appendix III). For children in the control condition, the experimenter read the example passage slowly with a slight pause after each sentence. Before reading the story out loud, the experimenter introduced the participant to the characters in the story (either a male or female 10 year old child and his/her mum and dad) and where the story took place (i.e., the kitchen and the back garden). For children in the indexing condition, the experimenter also explained which playset piece corresponded to which character. It is important to note that the experimenter aimed for participants' introduction to the task be the same length for every child.

After the practical example, participants in the indexing condition were introduced to the characters (i.e. which doll is which character and the characters' relationship to each other) The experimenter then sat the main character (either Jenny or Isaac depending on the story) in its starting position. The mother and father characters were placed in a standing position to the side of the playset. The appropriate props (a baseball glove for Jenny's story and a bicycle for Isaac's story) were visible and placed in their appropriate positions for the start of the story. For the AE and control conditions, participants were told the characters' names and their relationship to each other before the story was read out loud in order to match the indexing condition's introduction. Children in the AE and control conditions never saw the playset.

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The experimenter gave each child a copy of the story face down (size 16 font) and asked him/her to turn it over when the experimenter began reading. The play set was visible (i.e. on a table in front of the child) for the indexing condition only. The participant was allowed to look at the paper version of the story whilst the experimenter read it out loud in order to become familiarised with the layout of the story on the page. Then the experimenter turned on the voice recorder and asked the child to read the story back to her. After the participant read the story out loud with or without the aid of the playset, the playset was covered and the experimenter chatted to the child for two minutes about what he/she liked to read (as a distractor task).

Recall Task. Immediately following the distractor task, participants were asked to tell the experimenter everything they remembered from the story (free recall). Every participant received one prompt (i.e. “what happened next” or “can you tell me any more?”). After the recall task, the experimenter turned off the voice recorder. The children were thanked for their time and received a small toy as a reward.

Scoring

Comprehension Assessment. The experimenter graded the comprehension assessments by comparing children's written answers to a list of acceptable answers (Neale, 1997). Children could earn up to one point per question (.5 points were also awarded for relevant partial answers to increase accuracy of comprehension scores). It is important to note allocating partial points does not correspond to the standardised Neale guidelines. Raw scores were used during the analysis rather than age-related or standardised scores because the test was not administered according to the guidelines in the manual (i.e. it was used as a listening, rather than a reading, comprehension task).

Recall Task. First, the audio recordings were transcribed and were then scored by two independent raters. All of the transcriptions were scored by one grader, but to make sure the coding was reliable, a second grader scored 10% of the answer sheets (i.e., seven), $Kappa = .95, p < .001$. It was decided before grading that correct idea units did not need to be recalled in the same order as in the story but had to be in reference to the same section of the story. Additionally, it was decided beforehand that idea units did not need to be recalled verbatim.

Reading Time. As an additional measure, the length of time it took each child to read the test story (seconds) was measured from an audio recording.

Results

The analyses focused on the proportion of idea units recalled as a function of condition and idea unit type¹. In all analyses, NARA-II score and age were used as covariates. Primary analyses evaluating the homogeneity of regression (slopes) assumption revealed that the relationships between the covariates and the total proportion of idea units recalled did not differ significantly as a function of condition, NARA-II $F(2, 66) = 0.49, p = .614$, age $F(2,66) = 1.59, p = .211$. In the first instance, three ANCOVAS were conducted, one for each dependent variable (idea unit type: descriptive, dialogic, action), in order to investigate the effect of condition (AE, indexing, control) on the recall of each idea-unit type (see Table 3 for the results from these three comparisons).

¹ In order to explore the effect of story-type on the proportion of idea units recalled, we conducted a 3(condition) x 2(story type), between-measures ANCOVA. The results revealed no main effect of story-type, $F(1,66) = .258, p = .613, \eta_p^2 = .004$, and no condition x story interaction, $F(2, 66) = .208, p = .812, \eta_p^2 = .006$. Thus, story type was not included as a factor in further analyses.

<Table 3 here>

Although all of the independent-measure ANCOVAs yielded non-significant results, the descriptive idea unit ANCOVA revealed a close-to-significant trend, $F(2,67) = 2.99, p = .057, \eta_p^2 = .082$. Planned comparisons (adjusted for multiple comparisons) revealed that the non-significant trend resulted from a significant difference in the proportion of descriptive idea units recalled between the AE and Control conditions, p (one-tailed) = .021. One-tailed adjustments were used for the AE vs. Control comparison because the benefit of AE on recall of *descriptive* idea units was predicted. More specifically, on average, participants in the AE condition recalled a significantly higher proportion of descriptive idea units ($M = .333$) than participants in the control condition ($M = .282$).

Additionally, in the descriptive idea unit ANCOVA, NARA-II score significantly contributed to the effect, $F(1,67) = 25.52, p < .001, \eta_p^2 = .276$. This result suggested that the recall task is a strong indicator of comprehension ability.

The results described above suggest that there was an effect of condition on descriptive idea units recalled when comparing the AE vs. Control conditions. In order to exclude an alternative explanation other than the effects of Active Experiencing on recall, namely that the result reflected differences in the length of time (in seconds) it took to read the story, we conducted an additional ANCOVA to look at the effect of condition on reading time. With NARA-II score and age as covariates, there was a significant effect of condition on reading time, $F(2,67) = 3.53, p = .035, \eta_p^2 = .095$. Again, NARA-II score significantly contributed to the effect of condition on reading time, $F(1,67) = 31.50, p < .001, \eta_p^2 = .320$. Pairwise comparisons (adjusted for multiple comparisons) revealed that the significant result arose from the difference between the Indexing and Control conditions, $p = .046$ (Indexing $M = 125.96$ s, Control $M = 96.57$ s), whereas there was no difference between the AE and

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Control conditions, $p = 1.00$ (AE $M = 105$ s). The comparable reading times between the AE and Control conditions refutes the possibility that the effect of condition on recall was the result of differences in reading time between conditions. To further investigate the relationship of reading time to reading ability, we explored correlations between reading time and the proportion of descriptive idea units recalled. There was a significant negative correlation between reading time and recall, $r = -.240$, $p = .043$, with longer reading times associated with poorer recall of idea units.

In order to determine if the AE and indexing conditions differentially improved recall for poorer comprehenders, an ANCOVA was conducted (see Table 4 for the results from all three analyses) to explore the effect of condition on the recall of action, descriptive and dialogic idea units for participants at or below the 50th percentile on the NARA-II (NARA-II score ≤ 14 ; AE $N = 15$, Indexing $N = 11$, Control $N = 11$). NARA-II and age were again included as covariates. Reading time was also included as a covariate because of its relation to comprehension ability (as demonstrated in the previous analysis). An evaluation of the homogeneity of regression (slopes) assumption revealed that the relationships between the covariates and the total proportion of idea units recalled did not differ significantly as a function of condition, NARA-II $F(2, 31) = 1.64$, $p = .211$, age $F(2,31) = 2.08$, $p = .142$, time $F(2,31) = 1.76$, $p = .189$. The results indicated that there was a significant effect of condition on the proportion of descriptive idea units recalled, $F(2, 32) = 5.34$, $p = .010$, $\eta_p^2 = .256$. Pairwise comparisons (adjusted for multiple comparisons) revealed that the significant statistic resulted from differences between the AE and Control conditions, p (one-tailed) = .007 and the Indexing and Control conditions, p (two-tailed) = .050. Two-tailed adjustments were used for the Indexing vs. Control comparison because the benefit of indexing on recall of *descriptive* idea units was not predicted. An evaluation of means revealed that participants in the AE and Indexing (AE $M = .307$, Indexing $M = .290$) conditions recalled a significantly

higher proportion of descriptive idea units than participants in the control condition ($M = .217$). Additionally, in the descriptive idea unit ANCOVA, NARA-II score significantly contributed to the effect, $F(1,32) = 14.08, p = .001, \eta_p^2 = .312$.

<Table 4 here>

Discussion

Based on previous research demonstrating the benefits of Active Experiencing and indexing related to children's memory for a story, the current study predicted that the indexing condition would improve children's recall of action idea units compared to the AE and control conditions whilst the AE condition would improve children's recall of dialogic and descriptive idea units. We also predicted that poorer comprehenders would benefit from both the AE and indexing conditions, based on research showing that poorer comprehenders benefited the most from training in skills related to reading comprehension (Yuill & Oakhill, 1988). In support of our hypotheses, we found that overall, children in the AE condition remembered more descriptive idea units than children in the control condition and that poorer comprehenders benefited from both embodiment techniques. An additional analysis refuted reading time as an alternative explanation for this finding. Instead, the analysis revealed that children in the indexing condition took significantly longer to read the test story and that longer reading time correlated with poorer recall. It is important to note that the current study did not find an effect of condition for the action or dialogic idea units.

This is the first study to compare the effects of two memory techniques, indexing and AE, which were previously discussed interchangeably because of their similar use of motor control to enhance recall (e.g., Cook et al., 2008; Cutica et al., 2014). In actuality, the AE and indexing conditions highlighted different aspects of the test stories, which affected children's

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memory of the story. Indexing encouraged children to visualise the story from a third person perspective (i.e., manipulating playset pieces to mimic the story's plotline) whilst AE encouraged children to adopt the gesture and emotional conviction of a story's various characters in order to adopt a first person perspective. The current study allowed us to unpack the effect of these nuanced differences on children's memory for a story. Although none of the analyses revealed a significant difference between the two conditions, the AE condition had a slight advantage on improving children's recall of descriptive idea units overall and for poorer comprehenders, whilst indexing only benefited poorer comprehenders.

The results demonstrate that visualising and manipulating a story's characters from a third person perspective was only useful for poorer comprehenders. This may have been because the indexing task only improved skills already perfected by skilled readers. For example, Glenberg et al. (2007) contended that indexing aided recall by assisting children in forming a mental model of the information (i.e., making the mental model more transparent). Whilst Glenberg et al. (2004) showed that younger readers (American first graders between the ages of 6 and 7) reading more simplistic passages benefited from this transparency, the skill may have been too basic to benefit the skilled readers in the current study (i.e., children between the ages of 7 and 11). Alternatively, the improved performance by children in the AE condition could have been the result of increased attention caused by increased engagement, neither of which was measured during the current study.

In contrast, both skilled and poorer comprehenders in the AE condition had improved recall, which suggests that AE benefits a broader population than indexing. In support of this contention, Noice and Noice (2001) found that AE helped university students memorise more dialogue in a beginner acting class (Noice & Noice, 2001). Thus, AE has the ability to enhance adult's and children's recall performance. The current study is the first of its kind to

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demonstrate the usefulness of active experiencing outside of the acting world and for children specifically.

In terms of how AE is improving recall, research on the usefulness of gesture suggests that gesture enhances recall by freeing up working memory to enhance the encoding process (Cook et al., 2008; Ping & Goldin-Meadow, 2010). The benefits of emotional expression, an indication of how much the reader relates to a text on an emotional level, alone for enhancing memory has been studied much less widely but the benefits have been theoretically attributed to embodied cognition (Glenberg & Kaschak, 2002). More specifically, Glenberg and Kaschak (2002) contended that memory and other higher cognitive processes are embedded in perceptual and emotional experience. Thus, enhancing one's emotional connection to a text could improve cognitive performance on tasks related to the text.

Limitations of the current study include no direct measures of engagement with the embodiment activity, or of the relation of engagement to effectiveness. Also, the duration of the current intervention was relatively short, which possibly limited the overall potential of the activities. Additionally, the length of participants' introduction to the task (including their introduction to the reading strategy and characters in the text) was not taken into account and thus, differences in length between conditions may have been an unintended methodological artefact.

Additionally, although all participants in the AE condition were encouraged to use gesture there was no direct measure of the type or amount of gesture used. Coding how each child gestured in the AE condition would have provided a clearer understanding of how gesturing benefits recall.

Future directions could explore how AE and indexing differentially affect more specialised processes necessary for the construction of a coherent mental model (e.g., inference-making, comprehension monitoring) over the course of a longer, multi-session

intervention. Additionally, it would be informative to compare and contrast the effects of different strategies for narrative texts vs. expository texts. It could also be useful for future investigations of embodiment interventions to explore *how* children read and recalled stories out loud (e.g., enthusiasm, use of character-voices, coherence). These comparisons could give an indication of children's attention, engagement and enjoyment whilst learning/using the strategies. Additionally, including more diverse measures of recall (i.e., drawing, visual recall) could increase our understanding of the benefits of embodiment techniques.

In conclusion, the current study compared the effects of Active Experiencing and indexing on recall and found that AE was useful for skilled and poorer comprehenders whilst indexing only benefited poorer comprehenders. Further research will help investigate exactly how gesture is benefiting children's memory for a story and what other cognitive skills may be involved.

Acknowledgements

This study was funded by a Junior Research Associates bursary from the University of Sussex. A special thanks to Graham Burgess for transcription and grading. We would also like to thank the staff and children at Elm Grove Primary School, West Rise Junior School, the Pied Piper Summer Play Scheme and the Impact Initiative Whitehawk Holiday Play Scheme for their participation. Additionally, thanks to the Sussex WORD lab for allowing us to recruit children from their database.

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Appendices

1. Test Stories

- a. Story 1- Jenny's Story: The summer holiday had just begun and Jenny was sitting eagerly at the kitchen table waiting for her father to get home. He promised her that they would play catch in the garden before supper and Jenny was really looking forward to it. As soon as she heard the front door unlock, Jenny stood up to greet her father, excited with anticipation. "Welcome home daddy" said Jenny as he made his way into the kitchen. To her surprise, Jenny's dad had a brand new glove with him. "Here you go, sweetheart," said dad, holding up the brand new toy; "I thought this would come in handy for our game today!" "Thank you so much, dad!" With the glove under his arm,

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Jenny's dad and Jenny walked into the back garden. Just as they made there way outside, Jenny realised she had forgotten something. "Dad, I'll be right back" she said. And with that, she went to the kitchen and kissed her mum on the cheek. "Don't worry mummy, we'll be back in time for dinner!" said Jenny to her mum.

- b. Story 2 – Isaac's Story: Today is Isaac's tenth birthday and Isaac was sitting with anticipation at the kitchen table wondering what his mum and dad had got him for his birthday. They promised him they would all join him for a family breakfast and Isaac couldn't wait. As soon as he heard foot steps, Isaac stood up to greet his mother, excited with anticipation. "How's my birthday boy doing?" asked Isaac's mum as she entered the kitchen. To his surprise, Isaac's mum did not have any presents with her. "I'm doing great, mum" replied Isaac, with a big grin; "I'm looking forward to our breakfast, this morning!" His mum continued, "Your father and I have a surprise for you, sweetheart." And with that, Isaac and his mum made their way into the back garden. Just as they made there way outside, Isaac saw his dad standing next to his new present, a bike. "Thank you so much, mum and dad!" Isaac went over to his new bike and kissed his dad on the cheek. "I love my new bike." said Isaac to his parents.
2. Example passage: "Jane walked into the kitchen after her first day of school. 'How was your day, sweetheart?' said Jane's dad 'It was great!' replied Jane."
3. Examples of physical movement for children in the AE condition (for the example passage):
 - a. Move arms to impersonate Jane walking into the kitchen
 - b. Place hands on hips in interest when reading the dad's dialogue

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- c. Give “thumb’s up” during Jane’s dialogue

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Table 1

Participant Characteristics

Measure	<u>AE group</u>		<u>Indexing group</u>		<u>Control group</u>		$F(2, 67)$	p
	M	SD	M	SD	M	SD		
Age (Months)	110.52	11.33	110.83	10.00	114.00	13.21	0.65	.524
Year at school	3.92	0.91	3.96	0.86	4.17	1.03	0.51	.604
NARA-II	15.22	7.05	15.31	6.94	15.76	6.45	0.06	.941

Table 2

Example test story

Idea Unit	Type
Today is Isaac's tenth birthday	Description
and Isaac was sitting at the kitchen table	Description
with anticipation	Description
wondering what his mum and dad had got him	Description
for his birthday	Description
They promised him they would all join him	Description
for a family breakfast	Description
and Isaac couldn't wait.	Description
As soon as he heard foot steps,	Description
Isaac stood up	Action
to greet his mother	Action
excited with anticipation.	Description
"How's my birthday boy doing?" asked Isaac's	
mum	Dialogue
as she entered the kitchen.	Action
To his surprise,	Description
Isaac's mum did not have any presents with her.	Description
"I'm doing great, mum" replied Isaac,	Dialogue
with a big grin;	Description
"I'm looking forward to our breakfast,	Dialogue
His mum continued, "Your father and I have a	
surprise for you, sweetheart."	Dialogue

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And with that, Isaac and his mum made their way	
into the back garden.	Action
Just as they made there way outside,	Description
Isaac saw his dad standing next to his new present,	Description
a bike.	Description
“Thank you so much, mum and dad!”	Dialogue
Isaac went over to his new bike	Action
and kissed his dad on the cheek.	Action
“I love my new bike.” said Isaac to his parents.	Dialogue

Table 3

Proportion recall as a function of idea unit type and condition

Idea unit type	<u>AE group</u>		<u>Indexing group</u>		<u>Control group</u>		<i>F</i> (2, 67)	<i>p</i>	η_p^2
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
Descriptive	.334	.101	.329	.114	.282	.102	2.99	.057.	.082.
Dialogic	.136	.129	.167	.134	.174	.154	0.38	.656	.012
Action	.208	.201	.254	.206	.265	.238	0.44	.645.	.013.
Total	.325	.103	.341	.124	.308	.126	N/A	N/A	N/A

Table 4

Proportion recall as a function of idea unit type and condition for poorer comprehenders

Idea unit type	<u>AE group</u>		<u>Indexing</u> <u>group</u>		<u>Control group</u>		$F(2,32)$	p	η_p^2
	M	SD	M	SD	M	SD			
Descriptive	.307	.077	.290	.074	.217	.093	5.34	.010	.256
Dialogic	.210	.180	.240	.241	.178	.179	0.33	.718	.021
Action	.422	.259	.364	.180	.379	.248	0.05	.953	.003
Total	.301	.097	.281	.079	.241	.100	N/A	N/A	N/A